

IN THE CLAIMS

The following listing of the claims is provided in accordance with 37 C.F.R. 1.121:

1. (currently amended) A system for detecting a rub in a turbomachine comprising:
a turbomachine comprising a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof;
sensors configured to monitor turbomachine conditions; and
an on site-monitor in communication with the sensors, wherein the on-site monitor is configured to analyze the turbomachine conditions to identify abnormal behavior indicative of a rub in at least near real time in the turbomachine between tip portions of the plurality of blades and corresponding seal portions of the turbomachine;
wherein the abnormal behavior comprises a high vibration amplitude relative to a baseline, or a high variation in vibration amplitude, or a sudden change in vibration amplitude, or a combination thereof.

2. (original) The system of claim 1 further comprising a server in communication with the on site monitor via an internet.

3. (currently amended) A computer implemented method for detecting a rub in a turbomachine, the method comprising:
monitoring turbomachine conditions, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof;
determining whether a rub is occurring between tip portions of the plurality of blades and corresponding seal portions of the turbomachine based at least in part on ~~a high vibration amplitude, or~~ a high variation in vibration amplitude, or a sudden change in vibration amplitude, or a combination thereof; and

outputting an indication of the rub to a computer display.

4. (currently amended) A storage medium encoded with a machine-readable computer program code for detecting whether a rub is occurring in a turbomachine, the storage medium including instructions for causing a computer to implement a method comprising:

obtaining data indicating turbomachine conditions, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof;

determining whether a rub is occurring between tip portions of the plurality of blades and corresponding seal portions of the turbomachine in at least near real time based at least in part on an abnormal vibration relative to a historical trend, wherein the abnormal vibration comprises a sudden change in vibration amplitude; and

outputting an indication of the rub to a computer display.

5.-50 (cancelled).

51. (currently amended) A system, comprising:

a turbomachine comprising a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof;

means for monitoring turbomachine conditions; and

means for detecting whether a rub is occurring in the turbomachine between tip portions of the plurality of blades and corresponding seal portions of the turbomachine in at least near real time based on an abnormal vibration value, an abnormal eccentricity value, an abnormal response to a transient condition, an abnormal response to a variation in load, an abnormal response to a variation in pressure, or an abnormal differential expansion of the stator and the rotor, or a combination thereof.

52. (previously presented) A system, comprising:

a plurality of turbomachine sensors configured to couple to a turbomachine comprising a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, wherein the plurality of turbomachine sensors is configured to sense operational parameters of the turbomachine; and

a rub detection system configured to monitor the plurality of turbomachine sensors and to detect a turbomachine rub event occurring between tip portions of the plurality of blades and corresponding seal portions of the turbomachine based on one or more abnormal conditions, wherein the abnormal conditions comprise an abnormal vibration value, an abnormal eccentricity value, an abnormal response to a transient condition, an abnormal response to a variation in load, an abnormal response to a variation in pressure, and an abnormal differential expansion of the stator and the rotor.

53. (cancelled)

54. (currently amended) A system, comprising:

a rub detection system configured to monitor operational parameters of a turbomachine comprising a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, wherein the rub detection system is configured to detect a turbomachine rub event occurring between tip portions of the plurality of blades and corresponding seal portions of the turbomachine based on one or more abnormal conditions, wherein the abnormal conditions comprise a high vibration amplitude relative to a baseline, a high variation in vibration amplitude, and a sudden change in vibration amplitude.

55. (previously presented) The system of claim 54, comprising a turbomachine, wherein the rub detection system is coupled to the turbomachine.

56. (previously presented) A computer implemented method, comprising:

analyzing turbomachine operational data to detect a rub event based on one or more abnormal conditions in the turbomachine, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, the rub event occurs between tip portions of the plurality of blades and corresponding seal portions of the turbomachine, and the one or more abnormal conditions comprise a high vibration amplitude, a high variation in vibration amplitude, a sudden change in vibration amplitude, an abnormal eccentricity value, an abnormal response to a transient condition, an abnormal response to a variation in load, an abnormal response to a variation in pressure, and an abnormal differential expansion of the stator and the rotor, and a combination thereof; and
outputting an indication of the rub event to a computer display.

57. (previously presented) The method of claim 56, comprising monitoring a turbomachine to obtain the operational data.

58. (previously presented) The method of claim 57, wherein monitoring comprises monitoring the turbomachine on-site.

59. (cancelled)

60. (previously presented) The method of claim 57, wherein monitoring comprises monitoring the operational data in real time.

61. (previously presented) The method of claim 56, wherein analyzing comprises detecting the rub event in real time with operation of a turbomachine.

62. (previously presented) The system of claim 1, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator.

63. (previously presented) The system of claim 1, wherein the turbomachine conditions comprise bearing vibration, temperature, pressure, eccentricity, axial displacement, load, and condenser pressure values.

64. (previously presented) The system of claim 3, wherein the blades are disposed on the rotor, or the stator, or any combination thereof and the seals are disposed on the rotor, or the stator, or any combination thereof.

65. (previously presented) The system of claim 3, wherein the turbomachine conditions comprise bearing vibration, temperature, and pressure.

66. (previously presented) The system of claim 4, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator.

67. (previously presented) The system of claim 4, wherein the turbomachine conditions comprise bearing vibration, or temperature, or axial displacement, or load, or condenser pressure values, or any combination thereof.

68. (previously presented) The system of claim 51, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator.

69. (previously presented) The system of claim 51, wherein the turbomachine conditions comprise temperature, eccentricity, load, and condenser pressure values.

70. (previously presented) The system of claim 52, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator.

71. (cancelled)

72. (previously presented) The system of claim 54, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator

73. (previously presented) The system of claim 54, wherein the operational parameters comprise eccentricity, or axial displacement, or load, or condenser pressure values, or any combination thereof.

74. (previously presented) The method of claim 56, wherein the plurality of blades is disposed on the rotor and the corresponding seal portions are disposed on the stator.

75. (cancelled)

76. (previously presented) The system of claim 1, wherein the abnormal behavior comprises a sudden change in vibration values during steady speed operation, axial noisiness during coast down of the turbomachine, abnormal eccentricity value when the turbomachine returns to turning gear after a rub event during deceleration, abnormal vibration during start up followed by abnormal eccentricity when the turbomachine was on turning gear, abnormal vibration followed by abnormal upper and lower shell metal temperature difference, high vibration response to first critical speed, high vibration response to second critical speed, overall vibration affected by variation in load, overall vibration affected by variation in condenser pressure, or abnormal vibration during abnormal differential expansion of the stator and the rotor, or a combination thereof.

77. (currently amended) A system, comprising:

a turbomachine monitor configured to identify abnormal operational events as an indication of a rub in at least near real time between components of a turbomachine, wherein the

abnormal operational events comprise an abnormal vibration value, an abnormal eccentricity value, an abnormal behavior associated with a transient condition, an abnormal behavior associated with a variation in load, an abnormal behavior associated with a variation in pressure, an abnormal steam characteristic of the turbomachine, an abnormal differential expansion, or a combination thereof.

78. (previously presented) The system of claim 77, wherein the abnormal operational events comprise a high vibration amplitude, a high variation in vibration amplitude, a sudden change in vibration amplitude, or a combination thereof.

79. (previously presented) The system of claim 77, wherein the abnormal operational events comprise an abnormal eccentricity amplitude and/or abnormal eccentricity change during turning of a component of the turbomachine.

80. (previously presented) The system of claim 77, wherein the abnormal operational events comprise abnormal behavior during the transient condition of a start up or a shut down of the turbomachine.

81. (previously presented) The system of claim 77, wherein the abnormal operational events comprise an abnormal load amplitude and/or abnormal load change associated with the turbomachine.

82. (previously presented) The system of claim 77, wherein the abnormal operational events comprise an abnormal pressure amplitude and/or abnormal pressure change associated with the turbomachine.

83. (previously presented) The system of claim 77, wherein the abnormal operational events comprise an abnormal amplitude and/or an abnormal change in a property of steam in the turbomachine.

84. (previously presented) The system of claim 77, wherein the abnormal operational events comprise the abnormal differential expansion of a stator and a rotor of the turbomachine.

85. (previously presented) The system of claim 77, wherein the abnormal operational events comprise the abnormal vibration value, the abnormal eccentricity value, the abnormal behavior associated with the transient condition, the abnormal behavior associated with the variation in load, the abnormal behavior associated with the variation in pressure, the abnormal steam characteristic of the turbomachine, and the abnormal differential expansion, each individually and in combinations with one another.

86. (previously presented) The system of claim 77, comprising the turbomachine having a plurality of sensors communicative with the turbomachine monitor.

87. (previously presented) The system of claim 86, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, wherein the turbomachine monitor is configured to monitor the possibility of the rub between tip portions of the plurality of blades and corresponding seal portions of the turbomachine.

88. (previously presented) The system of claim 77, wherein the turbomachine monitor is configured to monitor for the rub in at least near real time.

89. (previously presented) A system, comprising:

a turbomachine monitor configured to identify abnormal operational events as an indication of a rub between components of a turbomachine, wherein the abnormal operational events comprise a sudden change in vibration, a large variance in vibration relative to past data, or a large vibration amplitude relative to past data, or a combination thereof.

90. (previously presented) The system of claim 89, comprising the turbomachine having a plurality of sensors communicative with the turbomachine monitor.

91. (previously presented) The system of claim 90, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, wherein the turbomachine monitor is configured to monitor the possibility of the rub between tip portions of the plurality of blades and corresponding seal portions of the turbomachine.

92. (previously presented) The system of claim 89, wherein the turbomachine monitor is configured to monitor for the rub in at least near real time.

93. (currently amended) A system, comprising:

a turbomachine monitor configured to monitor for abnormal operational events to identify a possible rub between components of a turbomachine in at least near real time, wherein the abnormal operational events comprise a sudden change, or a high variation, or a high value, or a combination thereof, of an operational parameter of the turbomachine, wherein the operational parameter comprises vibration amplitude.

94. (currently amended) The system of claim 93, wherein the abnormal operational events comprise ~~an abnormal vibration value~~, an abnormal eccentricity value, an abnormal behavior associated with a transient condition, an abnormal behavior associated with a variation

in load, an abnormal behavior associated with a variation in pressure, an abnormal steam characteristic of the turbomachine, or an abnormal differential expansion, or a combination thereof.

95. (currently amended) The system of claim 93, wherein the abnormal operational events comprise ~~an abnormal vibration value~~, an abnormal eccentricity value, an abnormal behavior associated with a transient condition, an abnormal behavior associated with a variation in load, an abnormal behavior associated with a variation in pressure, an abnormal steam characteristic of the turbomachine, and an abnormal differential expansion, each individually and in combinations with one another.

96. (cancelled)

97. (previously presented) The system of claim 93, wherein the abnormal operational events comprise an abnormal eccentricity amplitude and/or abnormal eccentricity change during turning of a component of the turbomachine.

98. (previously presented) The system of claim 93, wherein the abnormal operational events comprise abnormal behavior during the transient condition of a start up or a shut down of the turbomachine.

99. (previously presented) The system of claim 93, wherein the abnormal operational events comprise an abnormal load amplitude and/or abnormal load change associated with the turbomachine.

100. (previously presented) The system of claim 93, wherein the abnormal operational events comprise an abnormal pressure amplitude and/or abnormal pressure change associated with the turbomachine.

101. (previously presented) The system of claim 93, wherein the abnormal operational events comprise an abnormal amplitude and/or an abnormal change in a property of steam in the turbomachine.

102. (previously presented) The system of claim 93, wherein the abnormal operational events comprise the abnormal differential expansion of a stator and a rotor of the turbomachine.

103. (previously presented) The system of claim 93, comprising the turbomachine having a plurality of sensors communicative with the turbomachine monitor.

104. (previously presented) The system of claim 103, wherein the turbomachine comprises a rotor, a stator, and a plurality of blades extending radially from the rotor, or the stator, or a combination thereof, wherein the turbomachine monitor is configured to monitor for the possible rub between tip portions of the plurality of blades and corresponding seal portions of the turbomachine.

105. (new) The system of claim 1, wherein the abnormal behavior comprises a sudden change in vibration amplitude.

106. (new) The system of claim 52, wherein the rub detection system is configured to monitor in real time.

107. (new) The system of claim 54, wherein rub detection system is configured to monitor in real time.